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EXAMINER

HUISMAN, DAVID J

ART UNIT

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 09/747,583	Applicant(s) LEIBHOLZ ET AL.	
	Examiner DAVID J. HUISMAN	Art Unit 2183	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 March 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 and 16-19 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 and 16-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 April 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Claims 1-13 and 16-19 have been examined.

Papers Submitted

2. It is hereby acknowledged that the following papers have been received and placed of record in the file: Petition, Amendment, and RCE as received on 3/16/2007.

Claim Objections

3. Claim 16 is objected to because of the following informalities: In the last line of the 2nd paragraph, please insert --window-- before “underflow”. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 1-13 and 16-19 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.
6. Referring to claim 1, the examiner has been unable to find support in the original disclosure for a trap that unconditionally performs at least one of a register window spill

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operation or a register window fill operation responsive to the condition that is detected as imminent. The passages pointed out by applicant on page 8 of the remarks do not appear to support "unconditional"

7. Referring to claim 16, the examiner has been unable to find support in the original disclosure for avoiding a trap by unconditionally performing at least one of a register window spill operation or a register window fill operation responsive to the condition determined as imminent. The passages pointed out by applicant on page 8 of the remarks do not appear to support "unconditional"

8. It is also noted with claims 1 and 16 that in claim 1, the trap does the unconditional performing whereas in claim 16, unconditional performing is done to avoid a trap (i.e., two different things are doing the unconditional performing). It is not clear if applicant is aware of this or not. This is also why claim 1 has been rejected below (with Lin) and claim 16 has not been (because a trap is unconditionally performed in Lin, but a trap is not avoided by unconditionally performing)

9. Claims 2-13 and 17-19 are rejected under 35 U.S.C 112, 1st paragraph, for failing to comply with the written description requirement, because they are dependent, either directly or indirectly, on a claim that fails to comply with the written description requirement.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

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(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

11. Claims 1-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Lin U.S. Patent Number 6,631,452 (as applied in the previous Office Action).

12. Referring to claim 1, Lin has taught a microprocessor, comprising:

- a) registers for holding values, wherein said registers are logically partitioned into register windows. See Fig.2, Fig.4, and column 4, lines 1-29, and note that the frames are the register windows.
- b) a storage for storing values held in the registers of the register windows. See Fig.2, Fig.4, and column 4, lines 1-29, and note the backing store.
- c) a detector for detecting that a register window overflow condition or a register window underflow condition is imminent, by determining if execution of any fetched instructions will result in a register window overflow condition or a register underflow condition, and an instruction generator responsive to the detector for generating at least one instruction to manipulate the storage to avoid a trap to avoid stalling the microprocessor, wherein the trap unconditionally performs at least one of a register window spill operation or a register window fill operation responsive to the condition that is detected as imminent. See column 2, line 47, to column 3, line 5, column 3, lines 59-67, and column 5, lines 26-41, and note that speculative spills/fills are performed when bandwidth is available. The speculative spills/fills are performed because the system anticipates that overflow/underflow is imminent due to an instruction that, when fetched, will require more storage than is available to a procedure or due an instruction that, when fetched, will access data that is no longer in the register file assigned to a procedure.

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See column 5, lines 26-41. The successful performance of speculative spills/fills eliminates the need for performing mandatory spills/fills (traps). See column 5, line 42, to column 6, line 2. In the case when a speculative spill/fill is successful, the mandatory spill/fill would be unnecessary as the speculative spill/fill has already completed the task to be performed by the mandatory spill/fill. This prevents the stall associated with the mandatory spill/fill from being incurred (note that mandatory implies unconditional execution). When a speculative spill/fill is successful, then the associated mandatory spill/fill is avoided. This is clearly Lin's intention as the purpose of Lin's system is to reduce stalls associated with mandatory spills/fills.

13. Referring to claim 2, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the detector and the instruction generator are implemented in hardware. See column 11, lines 1-15.

14. Referring to claim 3, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the microprocessor further comprises a cache for caching instructions (Fig.1, component 130) for introduction into an execution stage and wherein the detector examines the instructions in the cache to determine if a register window overflow condition is imminent by determining if execution of any of the fetched instructions will result in a register window overflow condition. It should be realized that by executing fetched instructions of the active procedure (from a cache), the system is detecting that an overflow is imminent, i.e., that the active procedure may need more registers. Therefore, speculative spills will be issued. The instructions in the cache are the same instructions that are to be executed. No matter what point the instructions are monitored, they are "the instructions in the cache". That is, applicant is not claiming that the instructions are monitored while in the cache and before being fetched from the

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cache for decoding, execution, etc. Applicant merely claims monitoring instructions in the cache and an instruction that is being executed is also an instruction in the cache as that is where it was fetched from.

15. Referring to claim 4, Lin has taught a microprocessor as described in claim 3. Lin has further taught that the detector looks for an instruction in the cache that stores contents of a register window in the registers when the registers have no available space for storing the contents (Lin column 7 line 45-column 8 line 15, column 5 line 46-column 6 line 2, abstract, figure 6, column 8 line 49-column 9 line 5).

16. Referring to claim 5, Lin has taught a microprocessor as described in claim 3. Lin has further taught that the detector examines how much storage space is available in the registers (Lin column 7 line 45-column 8 line 15, column 5 line 46-column 6 line 2, abstract, figure 6, column 8 line 49-column 9 line 5).

17. Referring to claim 6, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the microprocessor further comprises a cache for caching instructions for introduction into an execution stage and wherein the detector examines the instructions in the cache to determine if a register window underflow condition is imminent by determining if execution of the instructions will result in a register window underflow condition. It should be realized that by executing fetched instructions of the active procedure (from a cache), the system is detecting that an underflow is imminent, i.e. that an inactive procedure will be returned to (and not have the required data available). Therefore, speculative fills will be issued to speculatively load that data. The instructions in the cache are the same instructions that are to be executed. No matter what point the instructions are monitored, they are “the instructions in the cache”.

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That is, applicant is not claiming that the instructions are monitored while in the cache and before being fetched from the cache for decoding, execution, etc. Applicant merely claims monitoring instructions in the cache and an instruction that is being executed is also an instruction in the cache as that is where it was fetched from.

18. Referring to claim 7, Lin has taught a microprocessor as described in claim 6. Lin has further taught that the detector looks for an instruction in the cache that restores a register window when contents of the register window are stored on the stack rather than in the registers (Lin column 7 line 45-column 8 line 15, column 5 line 46-column 6 line 2, abstract, figure 6, column 8 line 49-column 9 line 5).

19. Referring to claim 8, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the detector detects solely whether a register window underflow condition is imminent (Lin column 11 lines 40-43).

20. Referring to claim 9, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the detector detects solely whether a register window overflow condition is imminent (Lin column 11 lines 35-39).

21. Referring to claim 10, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the detector detects both whether a register window overflow condition is imminent and whether a register window underflow condition is imminent. It should be noted that spills and fills are performed in response to detecting overflows and underflows, respectively.

22. Referring to claim 11, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the microprocessor further comprises an execution unit for executing the

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instruction generated by the instruction generator (Lin column 7 line 45-column 8 line 15, column 5 line 46-column 6 line 2, abstract, figure 4).

23. Referring to claim 12, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the microprocessor performs out of order execution of instructions (Lin column 3 lines 32-45; speculative processing by definition is not a certain operation, but is a prediction based on some information, and because of a misprediction, the wrong order of operations will occur).

24. Referring to claim 13, Lin has taught a microprocessor as described in claim 1. Lin has further taught that the instruction generator includes a second storage for holding the at least one instruction that is generated by the instruction generator (Lin column 7 line 45-column 8 line 15, column 5 line 46-column 6 line 2, abstract; it is inherent that some ROM or other memory would be available to hold the speculative operations, that the RSE chooses to executes).

25. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

26. Claims 1, 2, 6, 8, and 11-13 are rejected under 35 U.S.C. 102(b) as being anticipated by Eickemeyer et al., U.S. Patent No. 5,377,336 (herein referred to as Eickemeyer).

27. Referring to claim 1, Eickemeyer has taught a microprocessor, comprising:

a) registers for holding values, wherein said registers are logically partitioned into register windows. See Fig.2, and note the register file. A register file has multiple registers that are

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logically partitioned (separate logic for R1, R2, etc.). And, each register is a window of 1 register.

b) a storage for storing values held in the registers of the register windows. See Fig.2, component 104.

c) a detector for detecting that a register window overflow condition or a register window underflow condition is imminent, by determining if execution of any fetched instructions will result in a register window overflow condition or a register underflow condition, and an instruction generator responsive to the detector for generating at least one instruction to manipulate the storage to avoid a trap to avoid stalling the microprocessor, wherein the trap unconditionally performs at least one of a register window spill operation or a register window fill operation responsive to the condition that is detected as imminent. See column 3, lines 30-47, and claim 1. Note the system scans for load instructions prior to their execution, where loads require an access to storage to manage register window information. When a load is detected, the system determines that execution of the fetched load will result in register window underflow, which in Eickemeyer would be when the data to be loaded into the register is not in the cache (and so, the system would have to perform a load from main memory (trap), which would be performed unconditionally because for the load to execute, the data would have to be loaded from main memory). Also, see the abstract, column 3, lines 30-47, and claim 1. Note that in response to detecting the load, a prefetch instruction is generated in order to instruct the system to perform a prefetch operation. As a result, the system prefetches data which is ultimately written to a register. Hence, a prefetch is an operation associated with filling registers, i.e., it is a register fill operation.

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28. Referring to claim 2, Eickemeyer has taught a microprocessor as described in claim 1.

Eickemeyer has further taught that the detector and the instruction generator are implemented in hardware. See Fig.1 and Fig.2.

29. Referring to claim 6, Eickemeyer has taught a microprocessor as described in claim 1.

Eickemeyer has further taught that the microprocessor further comprises a cache for caching instructions for introduction into an execution stage and wherein the detector examines the instructions in the cache to determine if a register window underflow condition is imminent by determining if execution of the instructions will result in a register window underflow condition. See column 3, lines 30-47, and claim 1. Note the system scans for load instructions prior to their execution, where loads require an access to storage to manage register window information.

Note that the buffer of Eickemeyer is essentially a cache by definition. A cache, as is known, is a memory for holding recently accessed data items. In Eickemeyer, instructions are fetched into the buffer, so the buffer is holding recently accessed data items, and is therefore acting as a cache. When a load is detected, the system determines that execution of the fetched load will result in register window underflow, which in Eickemeyer would be when the data to be loaded into the register is not in the cache (and so, the system would have to perform a load from main memory).

30. Referring to claim 8, Eickemeyer has taught a microprocessor as described in claim 1.

Eickemeyer has further taught that the detector detects solely whether a register window underflow condition is imminent for reasons described above.

31. Referring to claim 11, Eickemeyer has taught a microprocessor as described in claim 1.

Eickemeyer has further taught that the microprocessor further comprises an execution unit for

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executing the instruction generated by the instruction generator. There must inherently be logic which executes a command.

32. Referring to claim 12, Eickemeyer has taught a microprocessor as described in claim 1. Eickemeyer has further taught that the microprocessor performs out of order execution of instructions. See column 11, lines 25-29.

33. Referring to claim 13, Eickemeyer has taught a microprocessor as described in claim 1. Eickemeyer has further taught that the instruction generator includes a second storage for holding the at least one instruction that is generated by the instruction generator. See Fig.2, component 210.

Response to Arguments

34. Applicant's arguments filed on March 16, 2007, have been fully considered but they are not persuasive.

35. Applicant argues the novelty/rejection of claim 1 on page 7 of the remarks, in substance that:

“The invention of Lin assumes that a register window overflow condition and register window underflow condition will potentially occur at some time in the future, thus it does not detect that a register window overflow condition or a register window underflow condition is imminent by determining if execution of any fetched instructions will result in one of a register window overflow or register window underflow. The outstanding Office Action states that the system of Lin “detects inactive procedures” and responds. Applicants respectfully submit that detecting inactive procedures is not equivalent to detecting an imminent spill or fill condition, as disclosed in the claimed invention of the present application.”

36. These arguments are not found persuasive for the following reasons:

a) The examiner disagrees that Lin does not detect imminent overflow or underflow conditions.

As previously stated, the processor detects that there are inactive procedures. By detecting the

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existence of an inactive procedure, the processor also detects imminent underflow/overflow conditions, as the processor will likely have to perform fills/spills at any moment in order to activate an inactive procedure. It is not simply the case of underflow/overflow potentially occurring, but the case of the underflow/overflow likely occurring, thereby making it imminent (note that “imminent” is defined as “likely to occur at any moment”, at least by dictionary.com). See column 1, lines 56-65, where Lin describes spilling/filling often in response to procedure changes. If something occurs often, then it is certainly likely to occur at any moment, and if it is likely to occur at any moment, then it is imminent.

37. Applicant argues the novelty/rejection of claim 1 on page 8 of the remarks, in substance that:

“Since Lin discloses a conditional operation while claims 1 and 16 disclose performing an unconditional operation upon detection that a register window overflow or a register window underflow is imminent, Lin does not disclose each and every element of independent claims 1 and 16, which are therefore patentable.”

38. These arguments are not found persuasive for the following reasons:

a) It should be noted that claim 1 calls for the trap being performed unconditionally. The examiner asserts that this is the case because the trap corresponds to mandatory fills/spills and mandatory implies unconditional. Fig.5 also shows that steps 510 and 520 are performed unconditionally.

39. Applicant argues the novelty/rejection of claim 1 on page 9 of the remarks, in substance that:

“Applicants respectfully submit that a detector for load instructions (as disclosed in Eickemeyer) is not equivalent to detector for detecting that a register window overflow condition

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or a register window underflow condition is imminent, by determining if execution of any fetched instructions will result in a register window overflow condition or a register underflow condition. In Eickemeyer, every load instruction in the instruction buffer results in a prefetch, column 7, lines 1-11. Eickemeyer does not determine if execution of any fetched instructions will result in a register window overflow condition or a register underflow condition.”

40. These arguments are not found persuasive for the following reasons:

a) By detecting a fetched load before it executes, it is detected that register underflow is imminent (likely to occur at any moment, i.e., when the load actually issues). That is, register underflow would occur when the data to be loaded into the specified register is not in cache (and a time-consuming main memory access must be made).

41. Regarding the argument in the last paragraph on page 9 of the remarks, the examiner asserts that this argument only applied to claims that are not rejected under Eickemeyer. Claim 1 does not require that the load be detected in the cache.

42. Regarding the argument in the first paragraph on page 10 of the remarks, the examiner asserts that applicant’s use of conditional language (i.e., “or”) allows Eickemeyer to anticipate claim 1 even if Eickemeyer only teaches detecting underflow and not overflow.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DAVID J. HUISMAN whose telephone number is (571)272-4168. The examiner can normally be reached on Monday-Friday (8:00-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Chan can be reached on (571) 272-4162. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David J. Huisman/
Primary Examiner, Art Unit 2183
July 9, 2008